

भारतीय मानक

पोतनिर्माण — विद्युत वेल्डिड स्टड कड़ी वाली एंकर जंजीरें
तथा संयोजी सांकलें और पिरकियाँ — विशिष्टि
(तीसरा पुनरीक्षण)

Indian Standard

SHIPBUILDING — ELECTRICALLY WELDED STUD LINK
ANCHOR CHAINS AND CONNECTING SHACKLES AND
SWIVELS — SPECIFICATION
(*Third Revision*)

ICS 47.020.50

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FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Shipbuilding Sectional Committee had been approved by the Transport Engineering Department Council.

This standard was originally issued in 1967 and subsequently revised in 1975 and 1994. In the second revision in 1994, major changes relate to inclusion of extra special steel for manufacturing Grade 3 chains, change of mechanical properties of materials and heat treatment of chains, besides bringing nominal diameters in line with International practices. In this revision exhaustive changes have been effected in dimensions and tolerances.

This standard is one of a series of Indian Standards on anchor chains, other standards in this series are:

<i>IS No.</i>	<i>Title</i>
4690 : 1968	Mooring buoy shackles
5859 : 1970	Tools for handling of anchor chains and attachments
4692 : 2010	Electrically welded studless link anchor chains and connecting shackles (<i>second revision</i>)

It is important to note that all dimensions specified in this standard are the dimensions of the various parts of anchor chains after the cables and shackles have been subjected to the statutory proof loads which they have satisfactorily withstood.

Each standard length of chain (27.5 m or part thereof) is connected to the adjoining length by a 'D' type joining shackle or lugless joining shackle (Kenter type). When 'D' type joining shackle is used, each length shall include one end link at each end. Each length of chain shall be provided with one 'D' type joining shackle and shall comprise an odd number of links exclusive of the joining shackle.

When kenter joining shackle is used, enlarged end links of increased dimensions are obviated. A common link acts as the end link in any one length of chain. Each length of chain shall be provided with one lugless shackle.

In the formulation of this standard considerable assistance has been derived from ISO 1704 : 2008 'Shipbuilding — Stud-link anchor chains' issued by the International Organization for Standardization.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SHIPBUILDING — ELECTRICALLY WELDED STUD LINK ANCHOR CHAINS AND CONNECTING SHACKLES AND SWIVELS — SPECIFICATION

(*Third Revision*)

1 SCOPE

This standard specifies the material, shape, dimensions and tolerances for the electrically welded stud link anchor chains for ships and its accessories.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

<i>IS No.</i>	<i>Title</i>
1608 : 1995	Mechanical testing of metals — Tensile testing (<i>third revision</i>)
1757 : 1995	Method for Charpy impact test (V notch) for metallic material (<i>second revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Stud Link — The link of an anchor chain with a stud across its minor axis.

3.2 Common Link — The stud link with which a chain is normally constituted (*see* Fig. 1).

3.3 Enlarged Link — The stud link of increased dimension to connect the end link with a common link (*see* Fig. 1).

3.4 End Link — The studless link of enlarged dimensions to enable the use of 'D' type joining shackle (*see* Fig. 1).

3.5 'D' Type Joining Shackle — 'D' type joining shackle is used for joining two consecutive lengths of anchor chains, this is also known as bolt type shackle (*see* Fig. 1).

3.6 End Shackle — End shackle is similar to 'D' type joining shackle but of different dimensions and used to connect the anchor with the anchor chain (*see* Fig. 1).

3.7 Kenter Type Joining Shackle — This type of shackle, when assembled, resembles the stud link and used for joining two consecutive lengths of anchor chains (*see* Fig. 1).

3.8 Shackle Retaining Pin — The retaining pin used in 'D' type joining shackles and end shackles shall be a taper pin having a taper of not less than 1 : 50 and not more than 1:16 on the diameter. The retaining pin used in Kenter type joining shackles shall be a taper pin having a taper of not less than 1 : 50 and not more than 1 : 32 on the diameter. The nominal diameter of the taper pin shall be $0.37 \times d$.

Taper pins shall be either of stainless steel or tin-coated carbon steel. If tin-coated, this shall be either by a hot-dip process or electroplating.

3.9 Swivel Adapter — The swivel adapter consists of a swivel with an enlarged link and common link or end link at one end and an enlarged link and end link at the other end and is incorporated in the chain cable to prevent twisting (*see* Fig. 1).

3.10 Nominal Size — The designated diameter of the common link in millimetres referred to as '*d*'.

4 MATERIAL

4.1 Steel used for the manufacture of chains shall have the following chemical composition and mechanical properties.

4.1.1 Chemical Composition of Chain Cable and Fittings

Grade	Chemical Composition, Percent					
	C Max	Si	Mn	P Max	S Max	Al
Mild steel (Grade 1)	0.20	0.15-0.35	0.40 <i>Min</i>	0.040	0.040	—
Special steel (Grade 2)	0.24	0.15-0.35	1.60 <i>Max</i>	0.035	0.035	0.02, <i>Min</i> ¹⁾
Extra special (Grade 3)	0.33	0.15-0.35	1.90 <i>Max</i>	0.040	0.040	0.065, <i>Max</i> ¹⁾

¹⁾ Aluminium may be partly replaced by other grain refining elements like Nb and V.

4.1.2 Mechanical Properties of Finished Chain Cable and Fittings

Grade	Tensile Strength N/mm ²	Elongation on 5.65√A, Percent <i>Min</i>	Reduction in Area, Percent <i>Min</i>	Charpy V-notch Impact Test at 0°C <i>J, Min (Average of 3 Tests)</i>
Mild steel (Grade 1)	300-490	30	—	—
Special steel (Grade 2)	490-690	22	—	—
Extra special (Grade 3)	690, <i>Min</i>	17	40	Opposite to weld – 60J Notch positioned at weld – 50J

4.2 Studs

When studs are inserted and pressed into position, they shall be forged and stamped. Cast steel studs may also be used. The properties of the steel used shall not be inferior to the steel used for chain links. For Grade 3 chain cables, studs, if required, may be welded to the chain on one side all around the periphery of the stud. However, if the quality of the welding is of high standard partial peripheral welding of the studs may be accepted provided that welds are made at the sides of the stud and that each run extends continuously for atleast 25 percent of the stud periphery. The welding shall be done prior to the heat-treatment and opposite to the welded side of the chain.

4.3 The steel used for the manufacture of shackles and swivels shall in no respect be inferior to that used for the manufacture of chain links.

4.4 Testing of Material**4.4.1 Selection of Test Pieces**

For Grade 1 and Grade 2 chains, the bar material may be tested either in the 'as rolled' condition or after heat-treatment. For Grade 3 chains, the material shall be tested after heat-treatment in full cross-section and in a manner simulating the heat-treatment applied to finished chain.

4.4.2 Selection of test pieces shall be one tensile piece from every lot of 50 t or less of the same cast. For machined test pieces, the diameter of the reduced portion and the position of the test piece relative to bar cross-section shall be so selected that the piece is

representative of the average properties of bar. The tensile test shall be carried out in accordance with IS 1608. A specimen for tensile test shall be either the full section as rolled or shall be machined to a convenient size provided the area of the reduced portion is not less than 150 mm². In respect of Grade 3 chain of small diameter the largest practicable diameter may be used.

4.4.3 Impact test pieces are to be machined to the dimension and tolerances given in IS 1757.

5 PROCESS OF MANUFACTURE

Anchor chains shall be manufactured by a suitable electric butt welding process and after welding they shall be given the appropriate heat-treatment. Joining shackles and swivels shall be forged or cast and subsequently machined and heat treated.

6 CONSTRUCTION SHAPE AND DIMENSIONS

6.1 The construction, shape and dimensions shall be as shown in Fig. 1 to Fig. 8 and Tables 1 to 7.

6.2 The standard length of anchor chains shall be of 27.5 m approximately inclusive of shackle. Each length shall comprise of an odd number of links, exclusive of the joining shackle. Smaller lengths may be supplied to meet customer's requirements.

6.3 All links and shackles shall be of uniform shape. The inside radii of the common, enlarged and end links shall be sufficient to allow each link to bed properly and work freely. The inside radius of the end links shall be equal to half the inside width and their sides shall be parallel.

7 TOLERANCES

7.1 The allowable manufacturing tolerances on the nominal diameter of each link, shackle and swivel shall be as follows:.

<i>Nominal Diameter</i> mm	<i>Manufacturing Tolerance</i> mm
Up to 40	0 -1
More than 40 and up to 84	0 -2
More than 84 and up to 122	0 -3
Above 122	0 -4

7.2 The cross-sectional area at the crown of the link, shackle and swivel shall be not less than the area of a circle of nominal diameter.

7.3 The allowable manufacturing tolerances on the nominal diameter measured elsewhere on the link, shackle and swivel shall be $\begin{smallmatrix} +5 \\ -0 \end{smallmatrix}$ percent.

7.4 The allowable variation on a length of five links shall be $\begin{smallmatrix} +2.5 \\ -0 \end{smallmatrix}$ percent.

7.5 The allowable variation on the overall width and length of each link, shackle and swivel shall be ± 2.5 percent.

7.6 Approximate weight/m length of chain may be calculated approximately by the following formula:

$$\text{Weight / m} = 0.0216 (d)^2$$

where

d = nominal diameter, in mm.

8 HEAT TREATMENT

8.1 The chains shall be heat treated as per details given below:

<i>Material</i>	Mild Steel	Special Steel	Extra Special Steel
<i>Grade</i>	1	2	3
Heat treat- ment	As welded or Normalized	As welded ¹⁾ or Normalized	Quenched and tempered, normalized or normalized and tempered

¹⁾ Grade 2 chain may be supplied in as welded condition provided the breaking load is carried out from each length.

8.1.1 In all cases, heat treatment shall be carried out prior to the proof loading and breaking tests.

9 TESTING OF CHAIN LINKS, SHACKLES AND SWIVELS

9.1 Breaking Load Test

9.1.0 The breaking load test of chain links, shackles and swivels shall be made in accordance with **9.1.1**, **9.1.2** and **9.1.3**. Breaking load test of chains are to be carried out on each 3 link samples selected from every four lengths. Chain lengths shall have provision for extra links thus selected for breaking load test.

9.1.1 The selected 3 links shall be subjected to the breaking loads as specified in Table 8 according to grade and size of chain. The chains shall be considered to have passed this test, if the test links have shown no sign of failure after application of the required load.

9.1.2 Where a breaking test specimen fails, two additional specimens shall be cut from the same length of cable and subjected to breaking load test. The original cable of chain shall only be accepted in case both these specimens successfully pass the test. If this re-test is successful, the remaining three lengths of chain covered by the sample shall be considered to have passed the breaking load test. If this re-test also fails the length of the cable from which it was taken shall be rejected. The remaining lengths of chains shall be individually tested by taking a breaking load test specimen from each length of the batch.

9.1.3 The accessories shall also be subjected to a breaking load test as specified in Table 8 according to grade and size of chain with which these are used. In the case of swivels, one test sample shall be subjected to the breaking load test out of every 15 or less for cast swivels and out of 25 for forged swivels. One test sample for each 25 'D' type joining shackle or end shackle (one in 50 for Kenter joining shackle) or a fraction thereof shall be taken for every different size and the sample shall withstand the specified load.

9.1.4 All items subjected to breaking load shall be destroyed and not used in the outfit.

9.2 Proof Load Test

9.2.0 Proof load test of chain links, shackles and swivels shall be carried out as given in **9.2.1** and **9.2.2**.

9.2.1 Proof load testing of chains shall be carried out for every length of chain after it has passed the breaking load test as given in **9.1**. Proof load test on chains shall be carried out with the test loads shown in Table 1 according to grade and size of chains. The chains shall be accepted as having passed the proof load test, if the chain is free from flaws, cracks and other defects, after the application of the proof load test. The permanent

stretch in the length of the chain cable shall not exceed 5 percent of the original length.

9.2.2 If the chain shows any sign of cracks or other defects, the defective links shall be replaced by new links and the chain is again subjected to proof load test as given under **9.2.1**. However, the re-test shall not be permissible, if the number of defective links exceed 5 percent of the total number of links in 27.5 m length of the chain.

9.2.3 Proof load test of shackles and swivels shall be made by joining similar shackles and swivels, samples of which have passed the breaking load test as given in **9.1**. The shackles and swivels are accepted having passed the proof load test if they are free from flaws, cracks and other defects after the application of the proof load given in Table 8 according to grade and size of chains. Shackles and swivels may also be tested in conjunctions with the chains.

9.2.4 From completed Grade 3 chain cable, a tensile test piece and two sets of three Charpy V-notch impact test samples are to be taken from every four or less 27.5 m length of cable. The tensile test piece and one set of impact test pieces are to be taken clear of the weld. The other set of impact test pieces are to have the notch positioned at the weld line of the link. This can be checked by etching the machined impact test piece. The chains shall meet the requirement as laid down in **4.1**.

10 DESIGNATION

10.1 The nominal size of the chain cable shall be designated by the nominal diameter, d , of the common link.

10.2 The nominal size of other links, shackles and swivels shall be designated by the nominal diameter, d , of the common link.

11 INSPECTION

The inspection for shapes and dimensions of the chain, shackles and swivels shall be made after the completion of the proof test. The dimension of the chain, shackles and swivels shall conform to those in Fig. 1 to Fig. 8 and shall conform to the tolerances given in 7.

12 MARKING

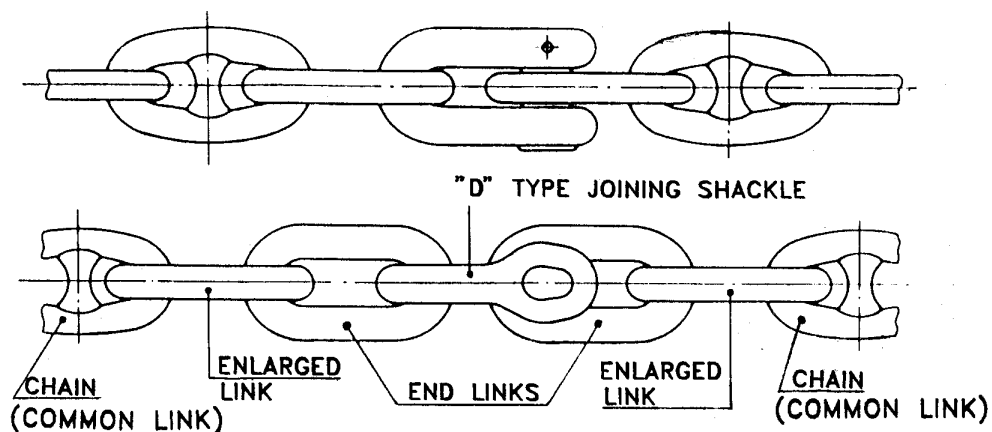
12.1 The first and last link of each chain and all shackles and swivels shall be marked with the following:

- a) Manufacturer's name or trade-mark;
- b) Batch number;
- c) Proof load, grade, size and month and year of test (last two digits); and
- d) Certification mark of the inspecting authority.

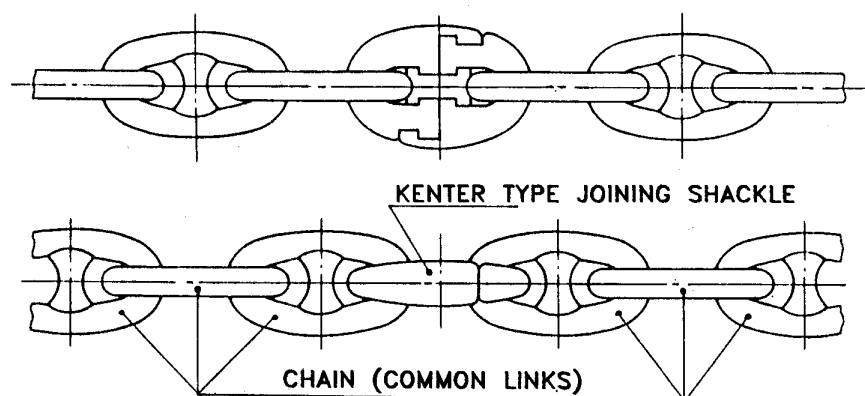
12.2 BIS Certification Marking

The product may also be marked with the Standard Mark.

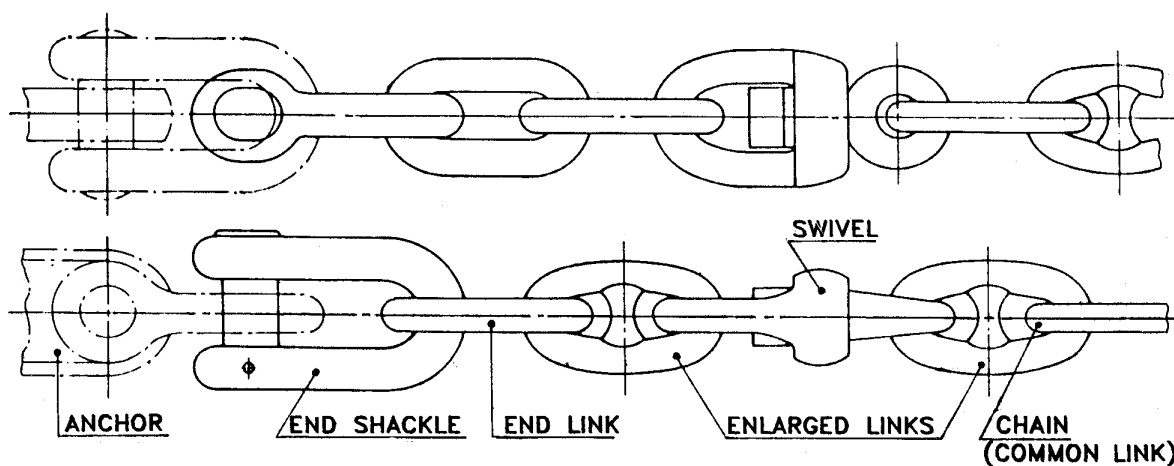
12.2.1 The use of the Standard Mark is governed by the provision of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.



1A Example of Joining Chain—Strands with "D" Type Joining Shackle

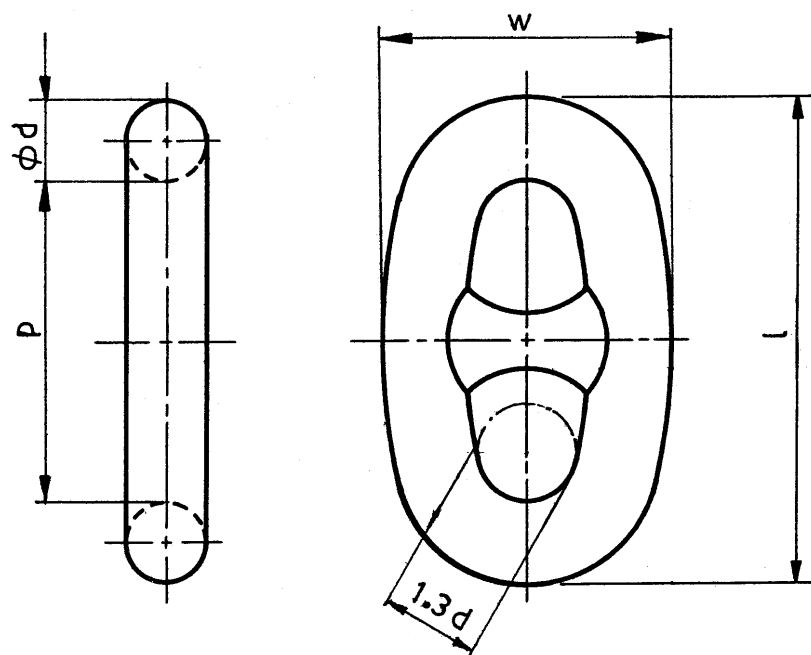


1B Example of Joining Chain—Strands with Kenter Type Joining Shackle



1C Example of Connecting Chain to Anchor

FIG. 1 EXAMPLES OF USE OF CONNECTING LINKS SHACKLES AND SWIVELS

**Key**

d = nominal diameter of common link
 l = $6 d$

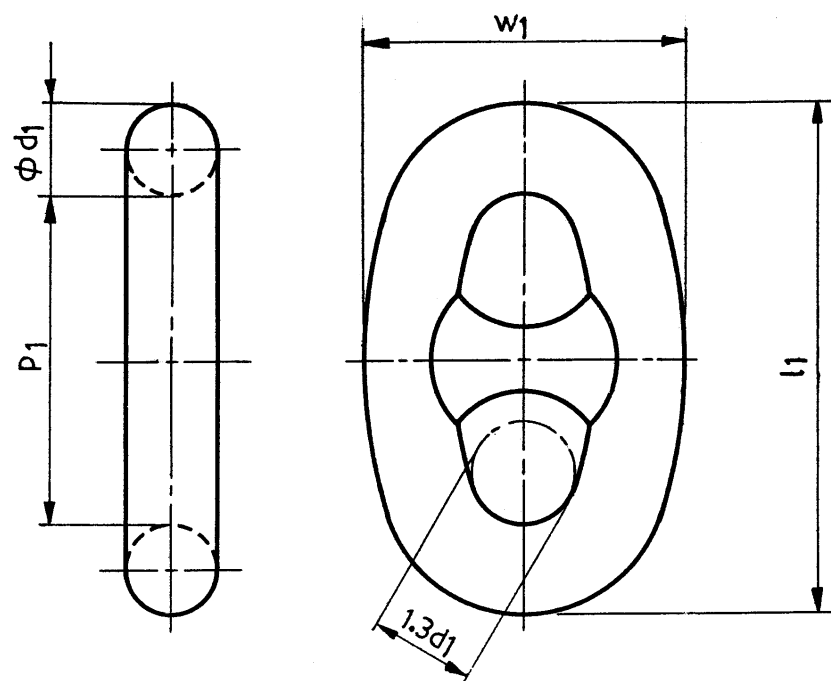
p = $4 d$
 w = $3.6 d$

FIG. 2 COMMON LINK

Table 1 Nominal Dimensions of Common Link
 (Clauses 6.1 and 9.2.1 and Fig. 2)

All dimensions in millimetres.

Nominal Size				Nominal Size			
d	l	p	w	d	l	p	w
(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
12.5	75	50	45	70	420	280	252
14	84	56	50	73	438	292	263
16	96	64	58	76	456	304	274
17.5	105	70	63	78	468	312	281
19	114	76	68	81	486	324	292
20.5	123	82	74	84	504	336	302
22	132	88	79	87	522	348	313
24	144	96	86	90	540	360	324
26	156	104	94	92	552	368	331
28	168	112	101	95	570	380	342
30	180	120	108	97	582	388	349
32	192	128	115	100	600	400	360
34	204	136	122	102	612	408	367
36	216	144	130	105	630	420	378
38	228	152	137	107	642	428	385
40	240	160	144	111	666	444	400
42	252	168	151	114	684	456	410
44	264	176	158	117	702	468	421
46	276	184	166	120	720	480	432
48	288	192	173	122	732	488	439
50	300	200	180	124	744	496	446
52	312	208	187	127	762	508	457
54	324	216	194	130	780	520	468
56	336	224	202	132	792	528	475
58	348	232	209	137	822	548	493
60	360	240	216	142	852	568	511
62	372	248	223	147	882	588	529
64	384	256	230	152	912	608	547
66	396	264	238	157	942	628	565
68	408	272	245	162	972	648	583

**Key** d = nominal diameter of common link d_1 = diameter of enlarged link = $1.1 d$ l_1 = $6 d_1$

$$p_1 = 4 d_1$$

$$w_1 = 3.6 d_1$$

FIG. 3 ENLARGED LINK

Table 2 Nominal Dimensions of Enlarged Link

(Clause 6.1 and Fig. 3)

All dimensions in millimetres.

Nominal Size (d , Common Stud Link)	d_1	l_1	p_1	w_1	Nominal Size (d , Common Stud Link)	d_1	l_1	p_1	w_1
(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
12.5	14	84	56	50	70	78	468	312	281
14	16	96	64	58	73	81	486	324	292
16	17.5	105	70	63	76	84	504	336	302
17.5	19	114	76	68	78	87	510	340	306
19	20.5	123	82	74	81	90	540	360	324
20.5	22	132	88	79	84	92	552	368	331
22	24	144	96	86	87	97	582	388	349
24	26	156	104	94	90	100	600	400	360
26	28	168	112	101	92	102	612	408	367
28	30	180	120	108	95	105	630	420	378
30	34	204	136	122	97	107	642	428	385
32	36	216	144	130	100	111	666	444	400
34	38	228	152	137	102	111	672	448	403
36	40	240	160	144	105	114	684	456	410
38	42	252	168	151	107	117	702	468	421
40	44	264	176	158	111	122	732	488	439
42	46	276	184	166	114	124	744	496	446
44	48	288	192	173	117	130	780	520	468
46	50	300	200	180	120	132	792	528	475
48	54	324	216	194	122	137	822	548	493
50	56	336	224	202	124	137	822	548	493
52	58	348	232	209	127	142	852	568	511
54	60	360	240	216	130	142	852	568	511
56	62	372	248	223	132	147	882	588	529
58	64	384	256	230	137	152	912	608	547
60	66	396	264	238	142	157	942	628	568
62	68	408	272	245	147	162	972	648	583
64	70	420	280	252	152	167	1002	668	601
66	73	438	292	263	157	173	1038	692	623
68	76	456	304	274	162	178	1068	712	641

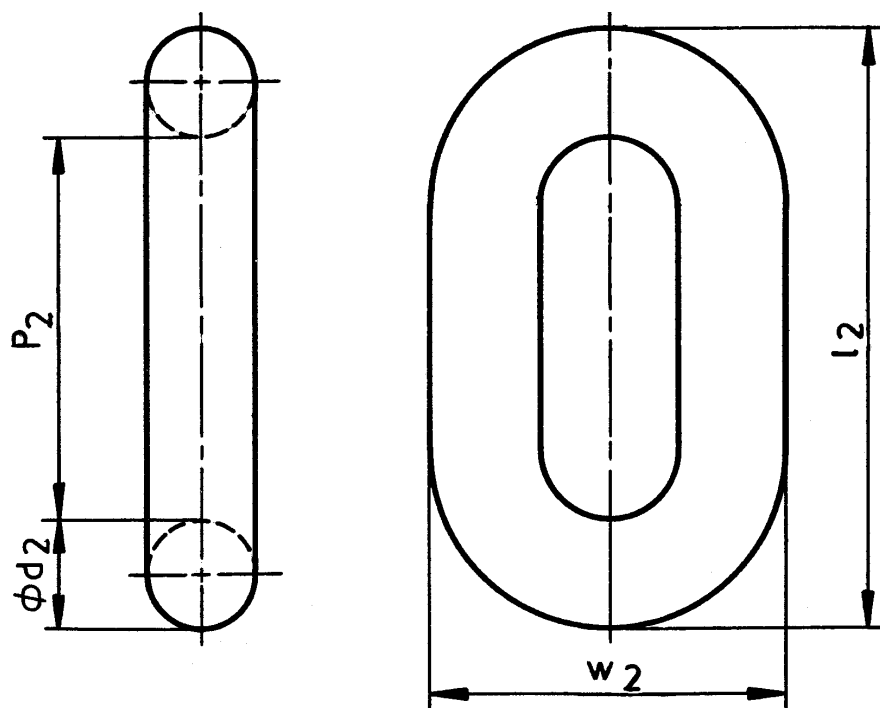
**Key** d = nominal diameter of common link $p_2 = 4.35 d$ d_2 = diameter of enlarged link = $1.2 d$ $w_2 = 4 d$ $l_2 = p_2 + 2 d_2 = 6.75 d$

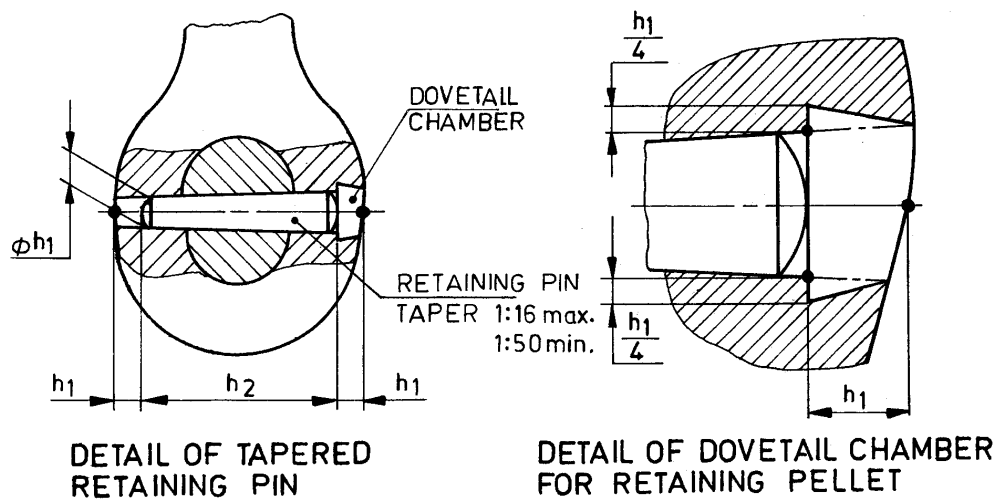
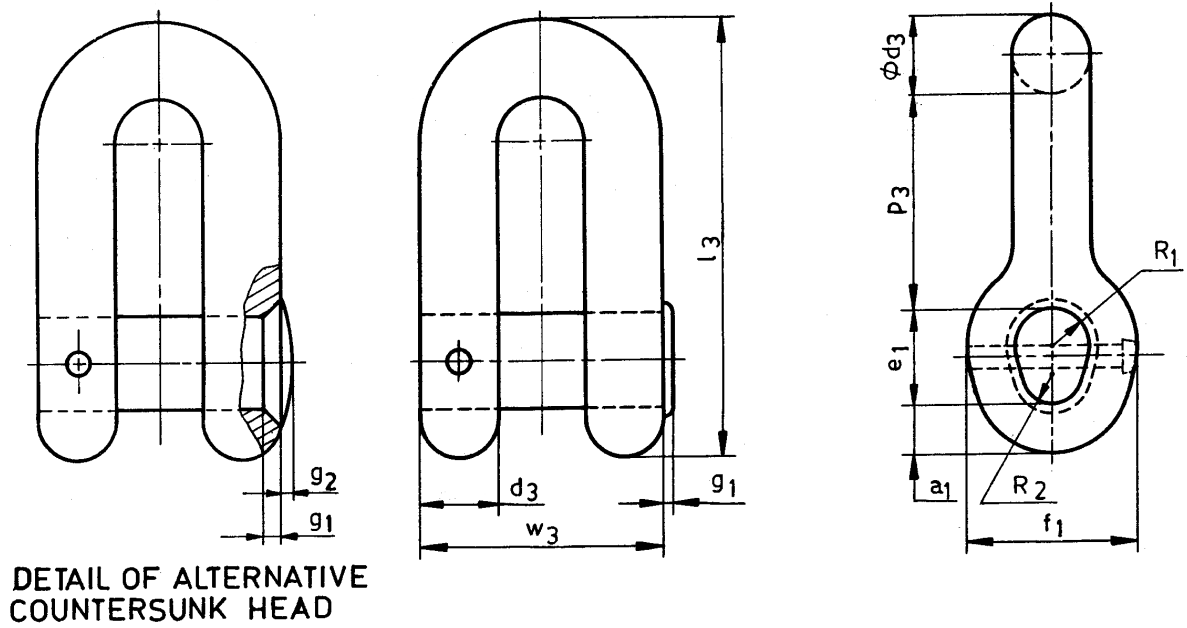
FIG. 4 END LINK

Table 3 Nominal Dimensions of End Link

(Clause 6.1 and Fig. 4)

All dimensions in millimetres.

Nominal Size (d , Common Stud Link)	d_2	l_2	p_2	w_2	Nominal Size (d , Common Stud Link)	d_2	l_2	p_2	w_2
(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
12.5	15	84	54	50	70	84	473	305	280
14	17	95	61	56	73	88	493	318	292
16	19	108	70	64	76	91	513	331	304
17.5	21	117	76	70	78	94	527	339	312
19	23	128	83	76	81	97	547	352	324
20.5	25	138	89	82	84	101	567	365	336
22	26	149	96	88	87	104	587	378	348
24	29	162	104	96	90	108	608	392	360
26	31	176	113	104	92	110	621	400	368
28	34	189	122	112	95	114	641	413	380
30	36	203	131	120	97	116	655	422	388
32	38	216	139	128	100	120	675	435	400
34	41	230	148	136	102	122	689	444	408
36	43	243	157	144	105	126	709	457	420
38	46	257	165	152	107	128	722	465	428
40	48	270	174	160	111	133	749	483	444
42	50	284	183	168	114	137	770	496	456
44	53	297	191	176	117	140	790	509	468
46	55	311	200	184	120	144	810	522	480
48	58	324	209	192	122	146	824	531	488
50	60	338	218	200	124	149	837	539	496
52	62	351	226	208	127	152	857	552	508
54	65	365	235	216	130	156	878	566	520
56	67	378	244	224	132	158	891	574	528
58	70	392	252	232	137	164	925	596	548
60	72	405	261	240	142	170	959	618	568
62	74	419	270	248	147	176	992	639	588
64	77	432	278	256	152	182	1026	661	608
66	79	446	287	264	157	188	1060	683	628
68	82	459	296	272	162	194	1094	705	648

**Key**

d = nominal diameter of common link

$p_3 = l_3 - (d_3 + a_1 + e_1) = 3.4 d$

$e_1 = 1.6 d$

$g_2 = 0.1 d$

$R_1 = 0.6 d$

d_3 = diameter of joining shackle = $1.3 d$

$w_3 = 4 d$

$f_1 = 2.8 d$

h_1 = nominal diameter of taper pin

$R_2 = 0.5 d$

$l_3 = 7.1 d$

$a_1 = 0.8 d$

$g_1 = 0.2 d$

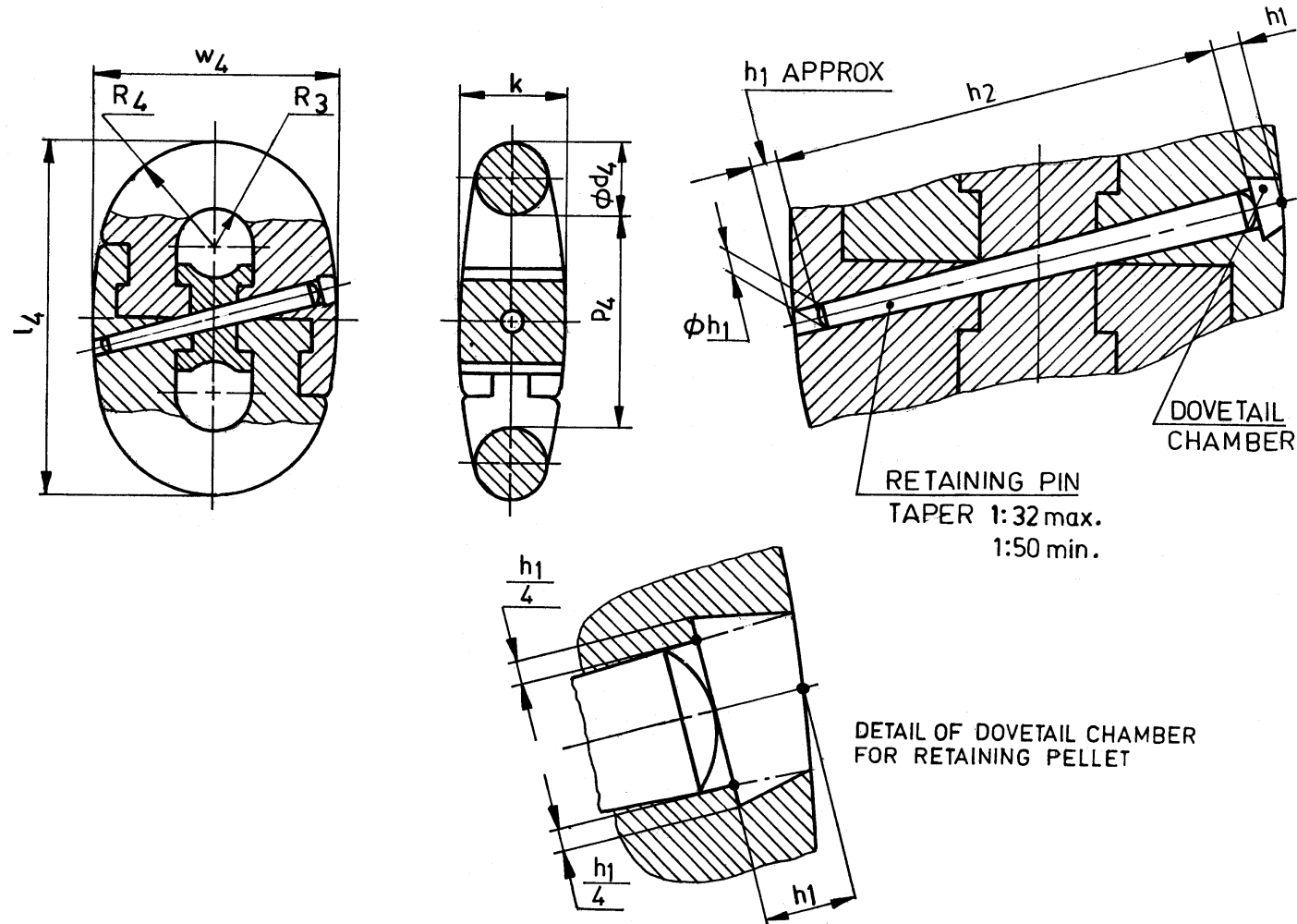
h_1 = nominal length of taper pin

FIG. 5 'D' TYPE JOINING SHACKLE

Table 4 Dimensions of ‘D’ Type Joining Shackle*(Clause 6.1 and Fig. 5)*

All dimensions in millimetres.

Nominal Size (<i>d</i> , Common Stud Link)	<i>d</i> ₃	<i>l</i> ₃	<i>p</i> ₃	<i>w</i> ₃	<i>a</i> ₁	<i>e</i> ₁	<i>f</i> ₁	<i>g</i> ₁	<i>g</i> ₂	<i>h</i> ₁	<i>h</i> ₂	2 <i>R</i> ₁	2 <i>R</i> ₂
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
12.5	16	89	43	50	10	20	35	2.5	1.3	4	25	15	12.5
14	18	99	48	56	11	22	39	3	1.4		28	17	14
16	21	114	54	64	13	26	45	3	1.6		32	19	16
17.5	23	124	60	70	14	28	49	3.5	1.8		38	21	17.5
19	25	135	65	76	15	30	53	4	2		40	23	19
20.5	27	146	70	82	16	33	57	4	2		45	25	20.5
22	29	156	75	88	18	35	62	4.4	2.2	6	50	26	22
24	31	170	82	96	19	38	67	5	2.4		55	29	24
26	34	185	88	104	21	42	73	5	2.6		60	31	26
28	36	199	95	112	22	45	78	5.6	2.8		65	34	28
30	39	213	102	120	24	48	84	6	3		70	36	30
32	42	227	109	128	26	51	90	6.4	3.2		80	38	32
34	44	241	116	136	27	54	95	7	3.4		85	41	34
36	47	256	122	144	29	58	101	7	3.6		80	43	36
38	49	270	129	152	30	61	106	7.6	3.8		85	46	38
40	52	284	136	160	32	64	112	8	4	10	90	48	40
42	55	298	143	168	34	67	118	8.4	4.2		100	50	42
44	57	312	150	176	35	70	123	9	4.4		100	53	44
46	60	327	156	184	37	74	129	9	4.6		110	55	46
48	62	341	163	192	38.5	77	134	9.5	4.8		110	58	48
50	65	355	170	200	40	80	140	10	5		115	60	50
52	68	369	177	208	42	83	146	10.4	5.2		120	62	52
54	70	383	184	216	43	86	151	11	5.4	12	125	65	54
56	73	398	190	224	45	90	157	11	5.6		130	67	56
58	75	412	197	232	46	93	162	11.6	5.8		140	70	58
60	78	426	204	240	48	96	168	12	6		140	72	60
62	81	440	211	248	50	99	174	12.4	6.2		150	74	62
64	83	454	218	256	51	102	179	13	6.4		150	77	64
66	86	469	224	264	53	106	185	13	6.6		150	79	66
68	88	483	231	272	54	109	190	13.6	6.8		160	82	68
70	91	497	238	280	56	112	196	14	7		160	84	70
73	95	518	248	292	58	117	204	14.6	7.3		170	88	73
76	99	540	258	304	61	122	213	15	7.6	16	180	91	76
78	101	554	265	312	62	125	218	15.6	7.8		190	94	78
81	105	575	275	324	65	130	227	16	8		190	97	81
84	109	596	286	336	67	134	235	17	8.4		200	101	84
87	113	618	296	348	70	139	244	17.4	8.7		200	104	87
90	117	639	306	360	72	144	252	18	9		220	108	90
92	120	653	313	368	74	147	258	18.4	9.2		220	110	92
95	124	675	323	380	76	152	266	19	9.5		220	114	95
97	126	689	330	388	78	155	272	19.4	9.7		240	116	97
100	130	710	340	400	80	160	280	20	10		240	120	100
102	133	724	347	408	82	163	286	20.4	10.2		240	122	102
105	137	746	357	420	84	168	294	21	10.5		260	126	105
107	139	760	364	428	86	171	300	21.4	10.7	20	260	128	107
111	144	788	377	444	89	178	311	22	11		260	133	111
114	148	809	388	456	91	182	319	23	11.4		280	137	114
117	152	831	398	468	94	187	328	23.4	11.7		280	140	117
120	156	852	408	480	96	192	336	24	12		300	144	120
122	159	866	415	488	98	195	342	24.5	12.3		300	146	122
124	161	880	422	496	99	198	347	25	12.4		300	149	124
127	165	902	432	508	102	203	356	25.4	12.7		300	152	127
130	169	923	442	520	104	208	364	26	13		320	156	130
132	172	937	449	528	106	211	370	26.4	13.2		320	158	132
137	178	973	466	548	110	219	384	27.5	13.7		320	164	137
142	185	1 008	483	568	114	227	398	28.4	14.2	25	350	170	142
147	191	1 044	500	588	118	235	412	29.4	14.7		350	176	147
152	198	1 079	517	608	122	243	426	30.4	15.2		350	182	152
157	204	1 115	534	628	126	251	440	31.4	15.7		400	188	157
162	211	1 150	551	648	130	259	454	32.4	16.2		400	194	162



Key

d = nominal diameter of common link

$w_4 = 4.2 d$

$R_3 = 0.67 d$

d_4 = diameter of lugless joining shackle = d

h = nominal diameter of taper pin

$R_4 = 1.83 d$

$l_4 = 6 d$

$h_2 = 3.4 d$ = length of taper pin

$k = 1.52 d$

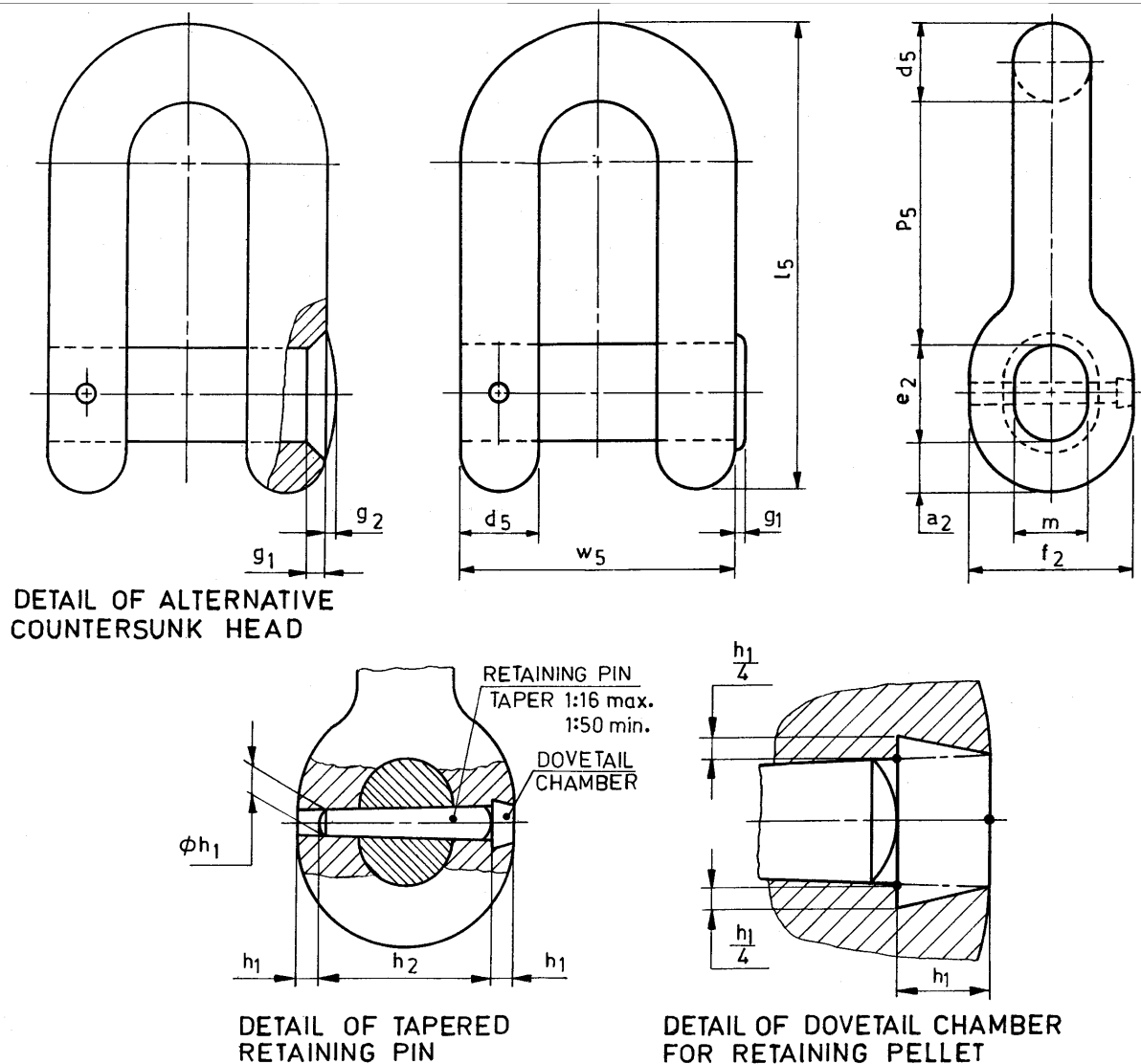
$P_4 = 4 d$

FIG. 6 KENTER TYPE JOINING SHACKLE

Table 5 Nominal Dimensions of Kenter Type Joining Shackle*(Clause 6.1 and Fig. 6)*

All dimensions in millimetres.

Nominal Size (<i>d</i> , Common Stud Link = <i>d</i> ₄)	<i>l</i> ₄	<i>p</i> ₄	<i>w</i> ₄	<i>h</i> ₁	<i>h</i> ₂	<i>K</i>	<i>R</i> ₃	<i>R</i> ₄
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
12.5	75	50	53	4	45	19	8.5	23
14	84	56	59	6	45	21	9.5	26
16	96	64	67		55	24	10.5	29
17.5	105	70	74		60	27	12	32
19	114	76	80		65	29	13	35
20.5	123	82	86		70	31	14	38
22	132	88	92		75	33	15	40
24	144	96	101	10	80	36	16	44
26	156	104	109		85	40	17.5	48
28	168	112	118		95	43	19	51
30	180	120	126		100	46	20	55
32	192	128	134		110	49	21.5	59
34	204	136	143	12	115	52	23	62
36	216	144	151		120	55	24	66
38	228	152	160		130	58	25	70
40	240	160	168		140	61	27	73
42	252	168	176		140	64	28	77
44	264	176	185	16	150	67	29	81
46	276	184	193		160	70	31	84
48	288	192	202		160	73	32	88
50	300	200	210		170	76	34	92
52	312	208	218		180	79	35	95
54	324	216	227	20	180	82	36	99
56	336	224	235		190	85	38	102
58	348	232	244		200	88	39	106
60	360	240	252		200	91	40	110
62	372	248	260		220	94	42	113
64	384	256	269		220	97	43	117
66	396	264	277	25	220	100	44	121
68	408	272	286		220	103	46	124
70	420	280	294		240	106	47	128
73	438	292	307		260	111	49	134
76	456	304	319		260	115	51	139
78	468	312	328		260	119	52	143
81	486	324	340	30	280	123	54	148
84	504	336	353		280	128	57	154
87	522	348	365		300	132	58	159
90	540	360	378		300	137	60	165
92	552	368	386		320	140	62	168
95	570	380	399	35	320	144	64	174
97	582	388	407		340	147	65	178
100	600	400	420		340	152	67	183
102	612	408	428		360	155	68	187
105	630	420	441		360	160	70	192
107	642	428	449		360	163	72	196
111	666	444	466	40	380	169	74	203
114	684	456	479		380	173	76	207
117	702	468	491		400	178	78	214
120	720	480	504		400	182	80	220
122	732	488	512		420	185	82	223
124	744	496	521		420	188	83	227
127	762	508	533		440	193	85	232
130	780	520	546	50	440	198	87	238
132	792	528	554		460	201	88	242
137	822	548	575		460	208	92	251
142	852	568	596		480	216	95	260
147	882	588	617		500	223	98	269
152	912	608	638		520	231	102	278
157	942	628	659		540	239	105	287
162	972	648	680		560	246	109	296

**Key**

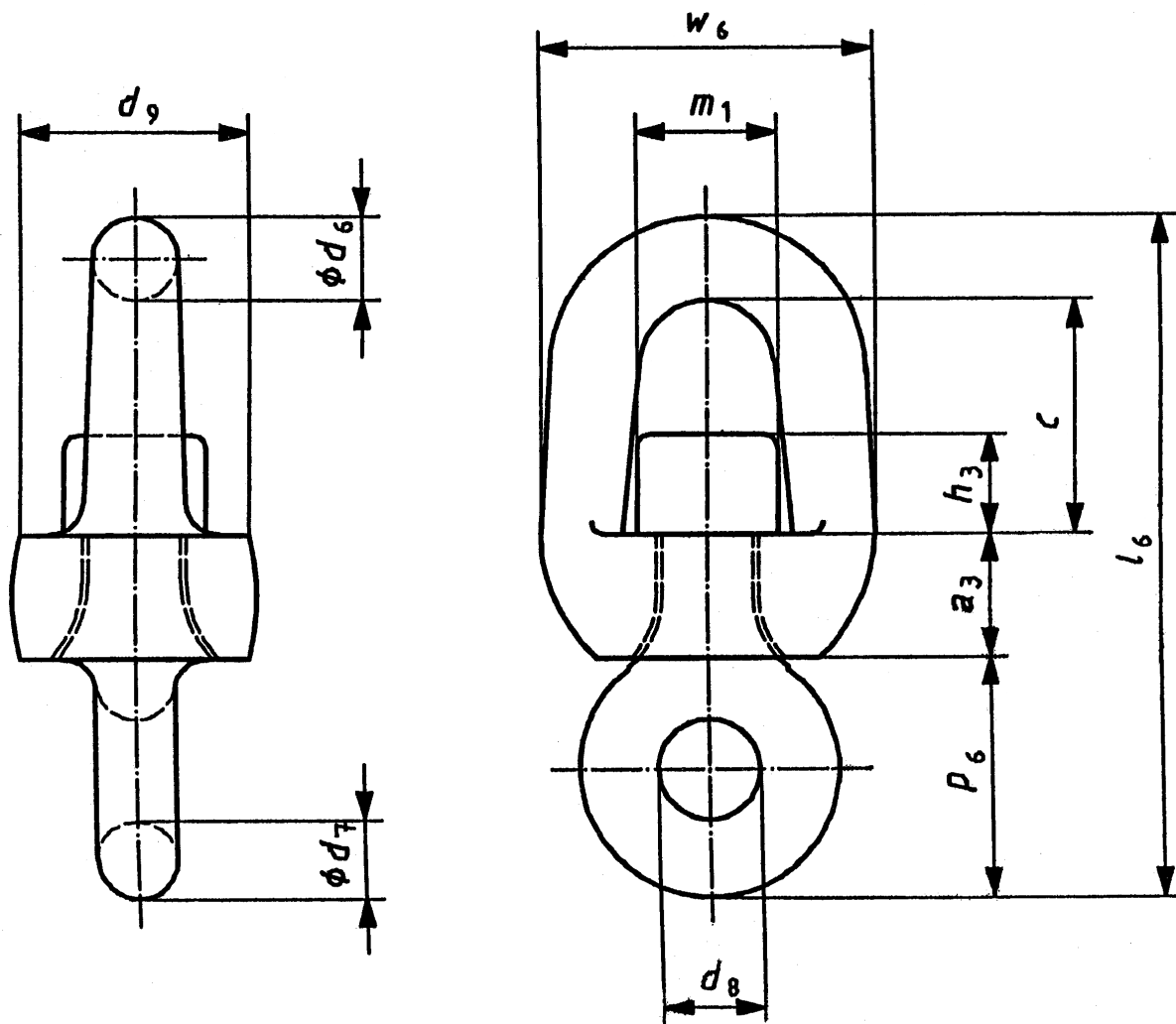
d = nominal diameter of common link	$l_2 = 8.7 d$	$e_2 = 1.8 d$	h_1 = nominal diameter of taper pin
d_5 = diameter of end	$p_5 = l_5 - (d_5 + a_2 + e_2) = 4.6 d$	$f_2 = 3.1 d$	h_2 = nominal length of taper pin
$= 1.4 d$	$w_5 = 5.2 d$	$g_1 = 0.2 d$	$m = 1.4 d$
	$a_2 = 0.9 d$	$g_2 = 0.1 d$	

FIG. 7 END SHACKLE

Table 6 Nominal Dimensions of End Shackle*(Clause 6.1 and Fig. 7)*

All dimensions in millimetres.

Nominal Size (<i>d</i> , Common Stud Link) (1)	<i>d</i> ₅ (2)	<i>l</i> ₅ (3)	<i>p</i> ₅ (4)	<i>w</i> ₅ (5)	<i>a</i> ₂ (6)	<i>e</i> ₂ (7)	<i>f</i> ₂ (8)	<i>g</i> ₁ (9)	<i>g</i> ₂ (10)	<i>h</i> ₁ (11)	<i>h</i> ₂ (12)	<i>m</i> (13)
12.5	18	109	58	65	11	23	39	2.5	1.3	4	28	18
14	20	122	64	73	13	25	43	3	1.4	6	30	20
16	22	139	74	83	14	29	50	3	1.6		35	22
17.5	25	152	81	91	16	32	54	3.5	1.8		40	25
19	27	165	87	99	17	34	59	4	1.9		45	27
20.5	29	178	94	107	19	37	64	4	2		45	29
22	31	191	101	114	20	40	68	4.4	2.2		50	31
24	34	209	110	125	22	43	74	5	2.4		55	34
26	36	226	120	135	23	46	81	5	2.6		60	37
28	39	244	129	146	25	50	87	5.6	2.8		70	39
30	42	261	138	156	27	54	93	6	3		75	42
32	45	278	147	166	29	58	99	6.4	3.2	10	80	45
34	48	296	156	177	31	61	105	7	3.4		85	48
36	50	313	166	187	32	65	112	7	3.6		85	50
38	53	331	175	198	34	69	118	7.6	3.8		90	53
40	56	348	184	208	36	72	124	8	4		95	56
42	59	365	193	218	38	76	130	8.4	4.2		100	59
44	62	383	202	229	40	79	136	9	4.4	12	110	62
46	64	400	212	239	41	83	143	9	4.6		115	64
48	67	418	221	250	43	86	149	9.6	4.8		115	67
50	70	435	230	260	45	90	155	10	5		120	70
52	73	452	239	270	47	93	161	10.4	5.2		125	73
54	76	470	248	281	49	97	167	11	5.4		130	76
56	78	487	258	291	50	101	174	11	5.6		140	78
58	81	505	267	302	52	104	180	11.6	5.8		140	81
60	84	522	276	312	54	108	186	12	6	16	150	84
62	87	539	285	322	56	112	192	12.4	6.2		160	87
64	90	557	294	333	58	115	198	13	6.4		160	90
66	92	574	304	343	59	119	205	13	6.6		160	92
68	95	592	313	354	61	122	211	13.6	6.8		160	95
70	98	609	322	364	63	126	217	14	7		170	98
73	102	635	336	380	66	131	226	14.6	7.3		180	102
76	106	661	350	395	68	137	236	15	7.6		190	106
78	109	679	359	406	70	140	242	15.6	7.8		190	109
81	113	705	373	421	73	146	251	16	8		200	113
84	118	731	386	437	76	151	260	17	8.4	20	200	118
87	122	757	400	452	78	157	270	17.4	8.7		220	122
90	126	783	414	468	81	162	279	18	9		220	126
92	129	800	423	478	83	166	285	18.4	9.2		240	129
95	133	827	437	494	86	171	295	19	9.5		240	133
97	136	844	446	504	87	175	301	19.4	9.7		240	136
100	140	870	460	520	90	180	310	20	10		240	140
102	143	887	469	530	92	184	316	20.4	10.2		260	143
105	147	914	483	546	95	189	326	21	10.5		260	147
107	150	931	492	556	96	193	332	21.4	10.7		260	150
111	155	966	511	577	100	199	344	22	11	25	280	155
114	160	992	524	593	103	205	353	23	11.4		280	160
117	164	1018	538	608	105	211	363	23.4	11.7		300	164
120	168	1044	552	624	108	216	372	24	12		300	168
122	171	1061	560	634	110	220	378	24.4	12.2		320	171
124	174	1079	570	645	112	223	384	25	12.4		320	174
127	178	1105	584	660	114	229	394	25.4	12.7		320	178
130	182	1131	598	676	117	234	403	26	13		320	182
132	185	1148	607	686	119	238	409	26.4	13.2		320	185
137	192	1192	630	712	123	247	425	27.4	13.7		350	192
142	199	1235	653	738	128	256	440	28.4	14.2		350	199
147	206	1279	676	764	132	265	456	29.4	14.7	25	350	206
152	213	1322	699	790	137	274	471	30.4	15.2		400	213
157	220	1366	722	816	141	283	487	31.4	15.7		400	220
162	227	1409	745	842	146	292	502	32.4	16.2		400	227

**Key**

1 d = nominal diameter of common stud link

d_6 = nominal diameter of swivel = $1.2 d$

$l_6 = 9.7 d$

$p_6 = d_9 = 3.4 d$

$w_6 = 4.7 d$

$d_7 = 1.1 d$

$a_3 = 1.75 d$

$m_1 = 2 d$

$h_3 = d_8 = 1.4 d$

$c = 3.35 d$

2 For nominal dimensions see Table 7.

FIG. 8 SWIVEL

Table 7 Nominal Dimensions of Swivel*(Clause 6.1 and Fig. 8)*

All dimensions in millimetres.

Nominal Size (<i>d</i> , Common Stud Link) (1)	<i>d</i> ₆ (2)	<i>l</i> ₆ (3)	<i>w</i> ₆ (4)	<i>d</i> ₇ (5)	<i>d</i> ₈ (6)	<i>d</i> ₉ (7)	<i>a</i> ₃ (8)	<i>c</i> (9)	<i>m</i> ₁ (10)
12.5	15	121	59	14	18	43	22	42	25
14	17	136	66	15	20	48	25	47	28
16	19	155	75	18	22	54	28	54	32
17.5	21	170	82	19	25	60	31	59	35
19	23	184	89	21	27	65	33	64	38
20.5	25	199	96	23	29	70	36	69	41
22	26	213	103	24	31	75	39	74	44
24	29	233	113	26	34	82	42	80	48
26	31	252	122	29	36	88	46	87	52
28	34	272	132	31	39	95	49	94	56
30	36	291	141	33	42	102	53	101	60
32	38	310	150	35	45	109	56	107	64
34	41	330	160	37	48	116	60	114	68
36	43	349	169	40	50	122	63	121	72
38	46	369	179	42	53	129	67	127	76
40	48	388	188	44	56	136	70	134	80
42	50	407	197	46	59	143	74	141	84
44	53	427	207	48	62	150	77	147	88
46	55	446	216	51	64	156	81	154	92
48	58	466	226	53	67	163	84	161	96
50	60	485	235	55	70	170	88	168	100
52	62	504	244	57	73	177	91	174	104
54	65	524	254	59	76	184	95	181	108
56	67	543	263	62	78	190	98	188	112
58	70	563	273	64	81	197	102	194	116
60	72	582	282	66	84	204	105	201	120
62	74	601	291	68	87	211	109	208	124
64	77	621	301	70	90	218	112	214	128
66	79	640	310	73	92	224	116	221	132
68	82	660	320	75	95	231	119	228	136
70	84	679	329	77	98	236	123	235	140
73	88	708	343	80	102	248	128	245	146
76	91	737	357	84	106	258	133	255	152
78	94	757	367	86	109	265	137	261	156
81	97	786	381	89	113	275	142	271	162
84	101	815	395	92	118	286	147	281	168
87	104	844	409	96	122	296	152	291	174
90	108	873	423	99	126	306	158	302	180
92	110	892	432	101	129	313	161	308	184
95	114	921	447	105	133	323	166	318	190
97	116	941	456	107	136	330	170	325	194
100	120	970	470	110	140	340	175	335	200
102	122	989	479	112	143	347	179	342	204
105	126	1 018	494	116	147	357	184	352	210
107	128	1 038	503	118	150	364	187	358	214
111	133	1 077	522	122	155	377	194	372	222
114	137	1 106	536	125	160	388	200	382	228
117	140	1 135	550	129	164	398	205	392	234
120	144	1 164	564	132	168	408	210	402	240
122	146	1 183	573	134	171	415	214	409	244
124	149	1 203	583	136	174	422	217	415	248
127	152	1 232	597	140	178	432	222	425	254
130	156	1 261	611	143	182	442	228	436	260
132	158	1 280	620	145	185	449	231	442	264
137	164	1 329	644	151	192	466	240	459	274
142	170	1 377	667	156	199	483	249	476	284
147	176	1 426	691	162	206	500	257	492	294
152	182	1 474	714	167	213	517	266	509	304
157	188	1 523	738	173	220	534	275	526	314
162	194	1 571	761	178	227	551	284	543	324

Table 8 Proof Loads and Breaking Loads of Stud Link Chain Cables
(Clauses 9.1.1, 9.1.3 and 9.2.3)

Nominal Diameter <i>d</i> mm (1)	Grade 1		Grade 2		Grade 3	
	Proof Load kN (2)	Breaking Load kN (3)	Proof Load kN (4)	Breaking Load kN (5)	Proof Load kN (6)	Breaking Load kN (7)
12.5	46.1	65.7	65.7	92.2	92.2	132.0
14	57.9	82.4	82.4	116.0	116.0	165.0
16	75.5	107.0	107.0	150.0	150.0	216.0
17.5	89.2	127.0	127.0	179.0	179.0	256.0
19	105.0	150.0	150.0	211.0	211.0	301.0
20.5	123.0	175.0	175.0	244.0	244.0	349.0
22	140.0	200.0	200.0	280.0	280.0	401.0
24	167.0	237.0	237.0	332.0	332.0	476.0
26	194.0	278.0	278.0	389.0	389.0	556.0
28	225.0	321.0	321.0	449.0	449.0	642.0
30	257.0	368.0	368.0	514.0	514.0	735.0
32	291.0	417.0	417.0	583.0	583.0	833.0
34	328.0	468.0	468.0	655.0	655.0	937.0
36	366.0	523.0	523.0	732.0	732.0	1 050.0
38	406.0	581.0	581.0	812.0	812.0	1 160.0
40	448.0	640.0	640.0	896.0	896.0	1 280.0
42	492.0	703.0	703.0	981.0	981.0	1 400.0
44	538.0	769.0	769.0	1 080.0	1 080.0	1 540.0
46	585.0	837.0	837.0	1 170.0	1 170.0	1 680.0
48	635.0	908.0	908.0	1 270.0	1 270.0	1 810.0
50	686.0	981.0	981.0	1 370.0	1 370.0	1 960.0
52	739.0	1 060.0	1 060.0	1 480.0	1 480.0	2 110.0
54	794.0	1 140.0	1 140.0	1 590.0	1 590.0	2 270.0
56	851.0	1 220.0	1 220.0	1 710.0	1 710.0	2 430.0
58	909.0	1 290.0	1 290.0	1 810.0	1 810.0	2 600.0
60	969.0	1 380.0	1 380.0	1 940.0	1 940.0	2 770.0
62	1 030.0	1 470.0	1 470.0	2 060.0	2 060.0	2 940.0
64	1 100.0	1 560.0	1 560.0	2 190.0	2 190.0	3 130.0
66	1 160.0	1 660.0	1 660.0	2 310.0	2 310.0	3 300.0
68	1 230.0	1 750.0	1 750.0	2 450.0	2 450.0	3 500.0
70	1 290.0	1 840.0	1 840.0	2 580.0	2 580.0	3 690.0
73	1 390.0	1 999.0	1 999.0	2 790.0	2 790.0	3 990.0
76	1 500.0	2 150.0	2 150.0	3 010.0	3 010.0	4 300.0
78	1 580.0	2 260.0	2 260.0	3 160.0	3 160.0	4 500.0
81	1 690.0	2 410.0	2 410.0	3 380.0	3 380.0	4 820.0
84	1 800.0	2 580.0	2 580.0	3 610.0	3 610.0	5 160.0
87	1 920.0	2 750.0	2 750.0	3 850.0	3 850.0	5 500.0
90	2 050.0	2 920.0	2 920.0	4 000.0	4 000.0	5 840.0
92	2 130.0	3 040.0	3 040.0	4 260.0	4 260.0	6 080.0
95	2 260.0	3 230.0	3 230.0	4 510.0	4 510.0	6 440.0
97	2 340.0	3 340.0	3 340.0	4 680.0	4 680.0	6 690.0
100	2 470.0	3 530.0	3 530.0	4 940.0	4 940.0	7 060.0
102	2 560.0	3 660.0	3 660.0	5 120.0	5 120.0	7 320.0
105	2 700.0	3 850.0	3 850.0	5 390.0	5 390.0	7 700.0
107	2 790.0	3 980.0	3 980.0	5 570.0	5 570.0	7 960.0
111	2 970.0	4 250.0	4 250.0	5 940.0	5 940.0	8 480.0
114	3 110.0	4 440.0	4 440.0	6 230.0	6 230.0	8 890.0
117	3 260.0	4 650.0	4 650.0	6 510.0	6 510.0	9 300.0
120	3 400.0	4 850.0	4 850.0	6 810.0	6 810.0	9 720.0
122	3 500.0	5 000.0	5 000.0	7 000.0	7 000.0	9 990.0
124	3 600.0	5 140.0	5 140.0	7 200.0	7 200.0	10 280.0
127	3 750.0	5 350.0	5 350.0	7 490.0	7 490.0	10 710.0
130	3 900.0	5 570.0	5 570.0	7 800.0	7 800.0	11 140.0
132	4 000.0	5 720.0	5 720.0	8 000.0	8 000.0	11 420.0
137	4 260.0	6 080.0	6 080.0	8 510.0	8 510.0	12 160.0
142	4 520.0	6 450.0	6 450.0	9 030.0	9 030.0	12 910.0
147	4 790.0	6 840.0	6 840.0	9 560.0	9 560.0	13 660.0
152	5 050.0	7 220.0	7 220.0	10 100.0	10 100.0	14 430.0
157	5 320.0	7 600.0	7 600.0	10 640.0	10 640.0	15 200.0
162	5 590.0	7 990.0	7 990.0	11 180.0	11 180.0	15 980.0

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